Where does stored nuclear waste go?

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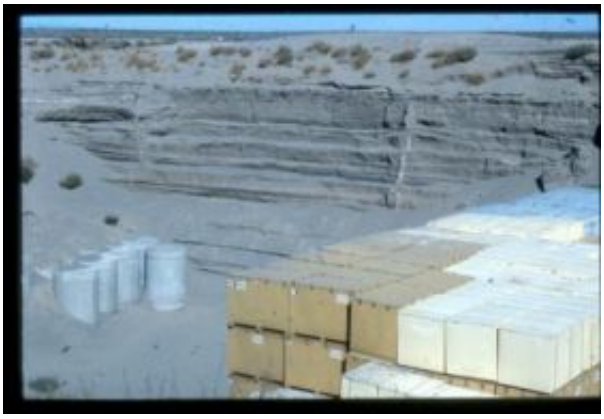

Millions of gallons of hazardous waste resulting from the nation's nuclear weapons program lie in a remote location in southeastern Washington state called Hanford. Credit: SSSA

Millions of gallons of hazardous waste resulting from the nation’s nuclear weapons program lie in a remote location in southeastern Washington state called Hanford. Beneath this desert landscape about two million curies of radioactivity and hundreds of thousands of tons of chemicals are captured within the stratified vadose zone below which gives rise to complex subsurface flow paths.

These paths create uncertainties about where the contaminants go and what happens to them. With the mighty Columbia River bordering much of the site, where these nuclear wastes migrate, their composition and how fast they are traveling are of vital importance to both people and the environment.

The November issue of *Vadose Zone Journal* features a series of papers addressing the mysteries within the vadose zone beneath Hanford. The series outlines scientific work funded by the Department of Energy and carried out by scientists at Pacific Northwest National Laboratory and contributing associates with other national laboratories, universities and contractors.

The detailed series outlines how researchers have investigated Hanford's vadose zone to better understand the migration of these contaminants, ultimately reducing or stemming their flow toward the Columbia River, thereby protecting the river and the people living downstream. By studying the geologic, biologic, geochemical and hydrologic conditions at the Hanford site, the researchers seek to understand and manipulate the factors that control contaminants' fate and transport.

To date, studies show that fine-grained sediment layers along with rain, snowfall and other climatic conditions affect contaminant transport. For three decades, scientists have studied what happens when water enters and exits the soil, particularly how it affects the movement of the contaminants under various conditions.

"Understanding how hydrology and chemistry are interacting below the land surface in the vadose zone and the factors that control those interactions are keys to ultimately dealing with the legacy from nuclear waste production at the Hanford site," said Glendon Gee, Laboratory Fellow at Pacific Northwest National Laboratory. Gee is lead author on the overview paper of the series.

Chemical studies indicate that a number of contaminants, such as cesium, react strongly with Hanford sediments and move only under extreme conditions. Researchers found that another contaminant, uranium, reacts with the sediments in complex ways and its migration varies under different conditions. Other contaminants, such as tritium

and nitrate, are relatively mobile. These contaminants have been transported deep into the vadose zone and reached the groundwater. Carbon tetrachloride and other organic compounds have moved in complex ways, as both vapor and liquid, and reached the groundwater.

Additional studies of the fate and transport of contaminants in the vadose zone are ongoing at the Hanford Site. These studies will characterize the extent of contaminant plumes, determine how fast or slow they are migrating and evaluate remediation solutions.

Source: Soil Science Society of America